CLAIMS

1. A method of optimizing cardiac resynchronization therapy over a patient's full range of activity for use in operating an implantable cardiac pacing device comprising the steps of:

(a) trending one or more selected cardiac conduction times over a range of corresponding activity levels of a patient; and

(b) optimizing the timing of a related pacing pulse based on said trending of one or more conduction times.

2. A method as in claim 1 wherein said trending step further comprises constructing a template based on accumulated data for each said selected conduction time in relation to one or more parameters of interest.

3. A method as in claim 2 wherein said accumulated data is acquired by measuring each said selected conduction time and logging the values in a periodic repeating programmable basis to produce cumulative data.

4. A method as in claim 2 wherein said one or more sensed parameters are selected from the group consisting of cycle length, activity level and minute ventilation.

5. A method as in claim 2 wherein said cardiac conduction times are selected from (RA-RV), (LA-LV), (RV-LV), (RA-LA), (RA-LV) and (LV_1-LV_2).

6. A method as in claim 3 wherein said one or more sensed parameters are selected from the group consisting of cycle length, activity level and minute ventilation.

7. A method as in claim 3 wherein said cardiac conduction times are selected from (RA-RV), (LA-LV), (RV-LV), (RA-LA), (RA-LV) and (LV_1-LV_2).

8. A method as in claim 4 wherein said cardiac conduction times are selected from (RA-RV), (LA-LV), (RV-LV), (RA-LA), (RA-LV) and (LV_1-LV_2).

9. A method as in claim 1 wherein said trending step further comprises constructing a best fit curve from scatter point data.

10. A method as in claim 9 wherein said accumulated data is acquired by measuring each said selected conduction time and logging the values in a periodic repeating programmable basis to produce cumulative data.

11. A method as in claim 10 wherein said one or more sensed parameters are selected from the group consisting of cycle length, activity level and minute ventilation.

12. A method as in claim 11 wherein said cardiac conduction times are selected from (RA-RV), (LA-LV), (RV-LV), (RA-LA), (RA-LV) and (LV_1-LV_2).

13. A method as in claim 1 further comprising the step of programming a suggested optimum pace timing into the operation of said pacing device.

14. A method as in claim 2 further including the step of periodically updating said template with new conduction time data to construct a new current template

15. A method as in claim 1 wherein said cardiac conduction times are selected from (RA-RV), (LA-LV), (RV-LV), (RA-LA), (RA-LV) and (LV_1-LV_2).

16. A method as in claim 15 further comprising the step of trending a plurality of conduction times.

17. A method of optimizing one or more inter site pacing delays over a patient's full range of activity for use in operating an implantable cardiac pacing device comprising the steps of:

(a) measuring one or more conduction times selected from the group consisting of (RA-RV), (LA-LV), (RV-LV), (RA-LA), (RA-LV) and (LV-LV) for a plurality of beats and logging the values using a periodic repeating programmable sampling interval to produce cumulative data;

(b) constructing a current template of one or more selected conduction times in relation to one or more sensed parameters of interest selected from the group consisting of cycle length, activity level and minute ventilation over a desired range of patient activity levels from said cumulative data; and

(c) based on a then current template derive a suggested optimum pacing delay.

18. A method as in claim 17 further comprising the step of programming a suggested optimum delay into the operation of said pacing device.

19. A method as in claim 17 further comprising the step of periodically updating one or more said templates with new conduction time data to construct one or more new current templates and thereby deriving one or more new suggested optimum delays.

20. A method as in claim 19 further comprising the step of programming updated suggested optimum delays into the operation of said pacing device.

21. A method as in claim 17 wherein the programmable sampling interval is such that sampling occurs at different times in successive 24-hour periods, such that eventually sampling occurs throughout said 24-hour period.

22. A method as in claim 17 further including the step of enabling a manual trigger mode that will force trending of conduction time during a specific intervention.

23. A method as in claim 17 wherein the collection of conduction time data is triggered based on a sensed parameter value.

24. A method as in claim 1 wherein the programmable sampling interval is such that sampling occurs at different times in successive 24-hour periods, such that eventually sampling occurs throughout said 24-hour period.

25. A method as in claim 1 further including the step of enabling a manual trigger mode that will force trending of conduction time during a specific intervention.

26. A method as in claim 1 wherein the collection of conduction time data is triggered based on a sensed parameter value.

27. A method of optimizing atrio-ventricular delay over a patient's full range of activity for use in operating an implantable cardiac pacing device comprising the steps of:

measuring atrio-ventricular conduction time for a plurality of beats and logging the values on a periodic repeating programmable basis to produce cumulative data;

constructing a current template of atrio-ventricular conduction time in relation to one or more other sensed parameters of interest over a desired range of patient activity levels from the said cumulative data;

based on a then current template derive a suggested optimum atrio-ventricular delay.

28. A method as in claim 27 wherein said one or more sensed parameters are selected from the group consisting of cycle length, activity level and minute ventilations.

29. A method as in claim 27 further comprising the step of programming the suggested optimum atrio-ventricular delay into the operation of said pacing device.

30. A method as in claim 27 further including the step of periodically updating said template with new atrio-ventricular conduction time data to construct a new current template.

31. A method as in claim 28 further including the step of periodically updating said template with new atrio-ventricular conduction time data to construct a new current template.

32. A method as in claim 29 further including the step of periodically updating said template with new atrio-ventricular conduction time data to construct a new current template.

33. A method as in claim 28 wherein said suggested optimum atrio-ventricular delay is a dynamic atrio-ventricular delay that changes as a function of one or more said sensed parameters of interest.

34. A method as in claim 29 wherein said suggested optimum atrio-ventricular delay is a dynamic atrio-ventricular delay that changes as a function of one or more said sensed parameters of interest.

35. A method as in claim 32 wherein said suggested optimum atrio-ventricular delay is a dynamic atrio-ventricular delay that changes as a function of one or more said sensed parameters of interest.

36. A method as in claim 32 wherein said suggested optimum atrio-ventricular delay is a dynamic atrio-ventricular delay and further comprising the step of changing the atrio-ventricular delay automatically when the template is updated with new atrio-ventricular conduction time data.

37. A method as in claim 29 wherein said suggested optimum atrio-ventricular delay is a fixed atrio-ventricular delay.

38. A method as in claim 34 further comprising the step of changing the atrio-ventricular delay automatically when the template is updated with new atrio-ventricular conduction time delay.

39. A method as in claim 27 wherein the measurement of said atrio-ventricular conduction time includes lengthening the then current AV delay so that intrinsic measurements can be made.

40. A method as in claim 27 wherein the data from each measurement is based on a discrete number of beats and is processed by exponential averaging and stored in incremental bins according to the value of the related parameter of interest and wherein a minimum number of beats must be averaged in a minimum number of bins to trigger template generation including updating.

41. A method as in claim 40 wherein the parameter of interest is selected from cycle length, activity level and minute ventilation.

42. A method as in claim 40 wherein the template is generated based on a best fit mathematical relation between atrio-ventricular conduction time and the parameter of interest.

43. A method as in claim 41 wherein the template is generated based on a best fit mathematical relation between atrio-ventricular conduction time and the parameter of interest.

44. A method as in claim 40 wherein the template is generated based on a programmed look-up table.

45. A method as in claim 15 wherein the template is generated based on a programmed look-up table.

46. A method as in claim 27 wherein the programmable sampling interval is such that sampling occurs at different times in successive 24-hour periods, such that eventually sampling occurs throughout said 24-hour period.

47. A method as in claim 27 further including a step of enabling a manual trigger mode that will force trending of atrio-ventricular conduction time during a specific intervention.

48. A method as in claim 47 wherein said intervention is a specific exercise test.

49. A method as in claim 27 wherein the collection AV atrio-ventricular conduction time data is triggered based on a sensed parameter value.

50. A method as in claim 27 wherein the atrio-ventricular conduction time is measured based on a selected morphological marker of ventricular depolarization and the atrio-ventricular delay is increased above the intrinsic during such measurements.

51. An implantable cardiac rhythm management device programmed to operate in accordance with claim 1.

52. An implantable cardiac rhythm management device programmed to operate in accordance with claim 17.

53. An implantable cardiac rhythm management device programmed to operate in accordance with claim 27.